Canadian Space Agency

2015–16

Departmental Performance Report

Supplementary Information Tables

Table of Contents

Details on Transfer Payment Programs of $5 Million or More

Name of transfer payment program	Contributions under the Canada/European Space Agency (ESA) Cooperation Agreement.
Start date	March 28, 2012 (ratification of the latest Agreement); September 20 2012 (approval of the revised Terms & Conditions)
End date	December 31, 2019 (end date of the latest Agreement).
Fiscal year for terms and conditions	The revised Terms & Conditions for the contributions, under the 2012–19 Cooperation Agreement, were approved on September 20, 2012.
Strategic Outcome	Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.
Link to department's Program Alignment Architecture	Program 1.3 Future Canadian Space Capacity Sub-Program 1.3.2 Space Innovation and Market Access Sub-Sub-Program 1.3.2.1 International Market Access
Description	Enhance Canadian industry's technological base and provide access to European markets for value-added products and services in the fields of Earth observation (EO), telecommunications and generic technological activities; foster the participation of Canadian academia and make possible the demonstration of Canadian space technologies in European microgravity and space exploration missions and programs. This is achieved through a financial contribution by the CSA to ESA optional programs.

Results achieved	For the period of January 1, 2015 to March 31, 2016, Canada has achieved a return coefficient of 107%, which is much higher than the minimum guaranteed to ESA Member states (i.e. 91% at end of 2019) and the ideal value (i.e. 100%). This result indicates that as a result of the Canada-ESA Agreement, Canada is successful in obtaining its fair share of ESA contracts although the period for the statistics is very short. Through Canada's participation in ESA Earth Observation programs, more specifically the Earth Observation Envelope Program and Global Monitoring for Environment and Security (GMES) Space Component, the CSA has continued to support Canadian companies in their involvement in developing advanced space-borne instruments and sub-systems, user-oriented applications, and ensuring access to the data for Canadians. For example, the Sentinel-3A satellite, part of Europe's Copernicus program, was launched on February 16, 2016. It provides systematic measurements of Earth's oceans, land, ice and atmosphere to support ocean forecasting systems as well as environmental and climate monitoring. MacDonald, Dettwiler and Associates (MDA) was a supplier of the antenna subsystem for the Synthetic Aperture Radar Altimeter, and NGC Aerospace Ltd. provided its expertise in attitude and orbit control systems. The CSA has supported the development and demonstration of innovative space technologies through its participation in ESA's General Space Technology Program. For example, Neptec Design Group et NGC Aerospace will be providing critical technologies for the formation flying mission Proba 3, to be launched at the end of 2019. Through its partnership with the ESA, the CSA has continued to position the Canadian industry and scientists in future scientific and technological developments related to the Aurora planetary exploration programs and the European Life and Physical Science (ELIPS) Program. Under the Aurora Program, the first of two ExoMars missions was launched on March 14, 2016, and carries a communication antenna subsystem built by MDA. MDA and Neptec Design Group

	continued the development of their respective subsystems for the rover as part of the second mission, which is now planned for 2020. Through the ELIPS Program, the Canadian company CALM Technologies was awarded a contract worth €1.7M to provide unique Canadian cell culture technology for use on the International Space Station. In addition, Canadians have taken advantage of the access to ESA facilities, specifically for a bed rest (three Canadian science teams) and an Antarctic isolation study (one science team), which are both opportunities that are not available in Canada. Canada's participation in the European Advanced Research in Telecommunications Systems (ARTES) has continued to allow our industry to access forward-looking studies on new telecommunications services, and to develop new satellites, technologies, equipment and applications.
Comments on variances	The variance of $1.6 million is due to the increase in Canada's payments (in accordance with the budgetary feasibility principle governing member states' and Canada's contributions to ESA), which is consistent with Canada's binding multiyear legal obligations with respect to its participation in ESA optional programs.
Audits completed or planned	N/A
Evaluations completed or planned	The program evaluation covering the period from April 2009 to December 2014 was completed and approved by the President on July 23, 2015. The next evaluation of the program is planned to begin in 2018–19 with a target approval date of December 2019.
Engagement of applicants and recipients	The CSA actively consulted the Canadian space sector (i.e. both industry and academia) and Government of Canada (GoC) organizations as part of the program selection process in preparation for the 2012 ESA Ministerial Council meeting during which ESA member states and Canada announced their position on contributions to the proposed ESA Programs. Similar consultations are planned for the ESA Ministerial Council meetings.

Performance Information (dollars)

Contributions under the Canada/European Space Agency (ESA) Cooperation Agreement.						
Type of Transfer Payment	**2013–14 Actual spending**	**2014–15 Actual spending**	**2015–16 Planned spending**	**2015–16 Total authorities available for use**	**2015–16 Actual spending (authorities used)**	**Variance (2015–16 actual minus 2015–16 planned)**
Total contributions	24,620,924	29,762,875	26,215,000	27,929,449	27,802,596	1,587,596
Total program	**24,620,924**	**29,762,875**	**26,215,000**	**27,929,449**	**27,802,596**	**1,587,596**

Name of transfer payment program	Class Grant and Contribution Program to Support Research, Awareness and Learning in Space Science and Technology.
Start date	October 1, 2009
End date	N/A – Ongoing program
Fiscal year for terms and conditions	2009–10
Strategic Outcome	Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.
Link to department's Program Alignment Architecture	Program 1.1 Space Data, Information and Services Sub-Program 1.1.1 Earth Orbit Satellite Missions and Technology Sub-Sub-Program 1.1.1.3 Scientific Missions Sub-Program 1.1.2 Ground Infrastructure Sub-Sub-Program 1.1.2.2 Data Handling Sub-Program 1.1.3 Space Data, Imagery and Services Utilization Development Sub-Sub-Program 1.1.3.1 Earth Observation Data and Imagery Utilization Program 1.2 Space Exploration Sub-Program 1.2.1 International Space Station Sub-Sub-Program 1.2.1.2 International Space Station Utilization Sub-Program 1.2.2 Exploration Missions and Technology Sub-Sub-Program 1.2.2.1 Space Astronomy Missions Sub-Program 1.2.3 Human Space Missions and Support Sub-Sub-Program 1.2.3.3 Health and Life Sciences Program 1.3 Future Canadian Space Capacity Program Sub-Program 1.3.1 Space Expertise and Proficiency Sub-Program 1.3.2 Space Innovation and Market Access Sub-Sub-Program 1.3.2.2 Enabling Technology Development
Description	This program supports knowledge development and innovation in the CSA's priority areas while increasing the awareness and participation of Canadians in space-related disciplines and activities. The program has two components: a) Research and b) Awareness and Learning. The Research component aims to support the development of science and technology; foster the continual development of a

	critical mass of researchers and highly qualified people in Canada; and support information gathering and space-related studies and research pertaining to Canadian Space Agency priorities. The Awareness and Learning component aims to provide learning opportunities to Canadian students in various space-related disciplines; to support the operations of organizations dedicated to space research and education; and to increase awareness of Canadian space science and technology among Canadian students and their participation in related activities. It should be noted that the CSA conducted a review of all of its programs. As a result of this review, the CSA no longer financially supports initiatives under the Awareness and Learning component aimed at elementary and secondary school students.
Results achieved	In 2015–16, Canadian universities and for-profit and not-for-profit organizations established and operating in Canada have made significant contributions to knowledge creation in space science and technology priority areas through 49 new research projects and five new Announcements of Opportunity (AOs) on the CSA website. For more details, consult the Grants & Contributions (G&C) AO webpage: http://asc-csa.gc.ca/eng/ao/default.asp. Results: All projects have resulted in 358 publications and 572 presentations, among which 61% were peer reviewed. 813 research team members were involved in the supported initiatives representing 307 persons / year in terms of Full Time Equivalence (FTE). From these Highly Qualified Personnel (HQP), 240 were Faculty members, 391 students and Post-Doctoral Fellows. A total of 128 research organizations have been involved in the funded projects (i.e. 40% been Universities, 17% Foreign Research organizations, 19% from the private sector and 24% other). 61% of research partners are international and 39% are national. A total of 33 projects declared leveraged funds from which eight projects reported international funding.
Comments on variances	Grants: During 2015–16, there was a new process to review all grant and contribution applications. This caused the delay in

	granting agreements provided for the year 2015–16. Contributions: The variance is mainly due to delays in the granting and establishment of contribution agreements under the Space Technology Development Program (STDP), which meant that the recipients could not incur all of the eligible expenditures planned for 2015–16. The balance of these planned expenditures will be incurred in 2016–17.
Audits completed or planned	2013–14
Evaluations completed or planned	In progress in 2015–16 and will be completed in 2016–17
Engagement of applicants and recipients	Since January 2012, an initiative to engage recipients has been undertaken through an automated annual follow-up of projects. The Agency has extended this initiative in order to establish a dialogue with potential applicants and recipients. Consultations, presentations to, and discussions with, the academic and industrial communities as well with other potential recipient groups, are ongoing and will continue.

Performance Information (dollars)

Class Grant and Contribution Program to Support Research, Awareness and Learning in Space Science and Technology						
Type of Transfer Payment	**2013–14 Actual spending**	**2014–15 Actual spending**	**2015–16 Planned spending**	**2015–16 Total authorities available for use**	**2015–16 Actual spending (authorities used)**	**Variance (2015–16 actual minus 2015–16 planned)**
Total grants	6,292,445	6,955,536	7,456,000	6,264,867	6,263,510	(1,192,490)
Total contributions	1,518,812	4,097,804	11,685,265	11,161,949	10,501,603	(1,183,662)
Total program	**7,811,257**	**11,053,340**	**19,141,265**	**17,426,816**	**16,765,113**	**(2,376,152)**

Status Report on Transformational and Major Crown Projects

Project name	RADARSAT Constellation Mission (RCM)
Description	The RADARSAT Constellation Mission (RCM) is the next generation of Canadian Earth observation (EO) radar satellites. RADARSAT-1 was launched in 1995 and continued its operation until March 2013. RADARSAT-2, developed by the private sector in partnership with the Government of Canada (GoC), was launched in 2007 for a seven-year mission, but given its current performance, it is expected to remain operational for several more years. Canada has established itself as a leading global supplier of C-band satellite radar data for EO. The successor mission to RADARSAT-2, the RCM will maintain the leadership and position of Canadian industry in space radar technology and value-added product markets. The RCM is comprised of three identical satellites. The launch of the constellation is planned for 2018. With a constellation, the time between successive imaging of a specific point on Earth is significantly reduced from 24 to four days. The creation of a three-satellite constellation will increase the frequency of available information, as well as the reliability of the system, making it better suited to the requirements of operations of both public and private users. The scope of the RCM Major Crown Project includes the requirement definition, design, development, manufacturing, integration, testing and launch of the satellites as well as the design, development, manufacturing and installation of the associated ground segment. One year of operation of the three-satellite constellation is also included as well as an application development program. The RCM will provide reliable data in all weather and illumination conditions in support of federal departments' operations and mandates in areas such as maritime surveillance, disaster management, environmental monitoring and natural resource management. The satellite constellation will provide average daily coverage capacity of

	most of Canada and its surrounding waters. In the North, the constellation will provide two to three times daily coverage capacity of the Arctic and the Northwest Passage. In support of the maritime surveillance requirements of federal departments, the RCM is the principal data source envisaged for wide-area surveillance of Canada's remote areas and marine approaches. Only satellite data can offer regular cost-effective information to task ships and aircraft in order to intercept suspicious vessels. The daily coverage of marine areas will also support fisheries monitoring, ice and iceberg monitoring, pollution monitoring, and integrated ocean and coastal zone management. The RCM's maritime surveillance capabilities also support Canadian sovereignty and security. The RCM satellites will be able to capture ship-originated Automatic Identification System (AIS) signals from space. The combination of space-based radar images and AIS signals will provide a powerful surveillance capacity over Canada's maritime approaches and elsewhere in the world. In support of disaster management, both in Canada and around the world, the RCM will provide critical and timely data to support disaster mitigation, warning, and response and recovery activities, while helping Canada meet its obligations with respect to international disaster relief. The types of disasters for which RCM data will be used for monitoring and relief purposes include floods, oil spills, volcanic eruptions, earthquakes and hurricanes. In support of environmental monitoring, the RCM will provide data for wide-area change detection in order to provide support for activities such as water monitoring, wetlands mapping, coastal change monitoring and changes in the permafrost in northern Canada. RCM data will contribute to the production of more accurate weather forecasts and warnings pertaining to marine conditions, winds, severe storms and floods. In support of natural resource management, RCM data will be a critical source of information to monitor the changing state of Canada's agricultural areas, forests and wildlife habitats. RCM data will also be

	used in the mining and energy sectors for resource exploration operations to ensure that critical infrastructure is monitored properly for safety and integrity. In addition, the RCM will sustain the development of Canadian high-technology design and manufacturing capabilities and the integration of satellite data into information products and services. Canada's space and geomatics industries will benefit from better positioning in international markets and privileged access to data deemed essential by many international users.
Project outcomes	This Major Crown Project (MCP) contributes to Program 1.1 Space Data, Information and Services, which includes the provision of space-based solutions and the progression of their utilization. It also serves to install and run ground infrastructure that processes the data and operates satellites. This Program utilizes space-based solutions to assist Government of Canada (GoC) organizations in delivering growing, diversified and cost-effective programs and services within the purview of their respective mandates, each related to key national priorities such as sovereignty, defence, safety and security, resource management, environmental monitoring and the North. It also provides academia with data required to perform its own research. The contribution of the MCP to the program objectives is measured through the Performance Measurement Framework (PMF) (i.e. Program Alignment Architecture (PAA) results and performance indicators). Program 1.1 Space Data, Information and Services Result: Government of Canada (GoC) organizations offer more diversified or cost-effective programs and services due to their utilization *of space-based solutions.* *Performance Indicator* #1: Number of new GoCs programs offering more diversified or efficient services. Sub-Program 1.1.1 Earth Orbit Satellite Missions and Technology Result: GoC organizations are using space-based data to deliver their mandate.

	Performance Indicator #1: Number of GoC programs using space data or derived information to deliver their mandate. Performance Indicator #2: Percentage of RADARSAT data used in program delivery.
Industrial benefits	The RCM is expected to generate significant industrial benefits in the space and Earth Observation sectors, such as employment, economic growth and improved productivity. Investments in RCM also support the growth of small and medium-sized companies as well as Canadian capabilities in terms of infrastructure and services. The prime contract includes a requirement for 70% Canadian content, excluding launch services and sub-systems for which there are no suppliers available in Canada. As of September 30, 2015 this corresponds to a Canadian content requirement of $388.1 million. For the same period, the CSA had provided the Canadian industry with funding of more than $448.2 million to carry out work resulting directly from the design of the RCM MCP, thus, surpassing the requirement. The prime contract also requires that 3.5% of the 70% Canadian content be sub-contracted in the Atlantic Canada region. For the same period, the actual Atlantic Canada content was $13.4 million, just below the requirement. The prime contract includes reporting obligations and performance measurements as well as financial penalties for not meeting the minimum Atlantic Canada content requirement.
Sponsoring department	Canadian Space Agency (CSA)
Contracting authority	Public Works and Government Services Canada (PWGSC)
Participating departments	Agriculture and Agri-Foods Canada Canadian Coast Guard Environment and Climate Change Canada Canadian Ice Service

	Fisheries and Oceans Canada Indigenous and Northern Affairs Canada Global Affairs Canada Indigenous and Northern Affairs Canada Innovation, Science and Economic Development Canada National Defence and the Canadian Armed Forces Natural Resources Canada Parks Canada Public Safety Canada Royal Canadian Mounted Police Statistics Canada Transport Canada
Prime contractor	MDA Systems Ltd. (a division of MacDonald, Dettwiler and Associates), Richmond, British Columbia
Major subcontractors	Tier 1 Major Sub-Contractors: - MDA Montreal, Ste-Anne-de-Bellevue, Quebec - Magellan Aerospace, Winnipeg, Manitoba - MDA, Halifax, Nova Scotia - SpaceX, Hawthorne, California, USA - Airbus Defence and Space, United Kingdom - Honeywell Aerospace, United Kingdom Tier 2 and Tier 3 Canadian Subcontractors: - Stelia Aerospace North America, Lunenburg, Nova Scotia - IMP Group, Halifax, Nova Scotia - DRS, Ottawa, Ontario - Mecachrome, Mirabel, Quebec - Maya, Montreal, Quebec
Project phase	Phase D – Implementation
Major milestones	Phase A: Requirement Definition (March 2008) Phase B: Preliminary Design (March 2010) Phase C: Detailed Design Review (November 2012) Phase D: Launch satellite #1, #2, and #3 (2018)

	Phase E1: Operations (part of MCP) (2020) Phase E2: Operations (not part of MCP) (2026)
Progress report and explanation of variances	On December 13, 2004, the Domestic Affairs Committee of Cabinet granted approval-in-principle to a 10-year program to implement a RADARSAT Constellation Mission (RCM) aimed at addressing the operational needs of users from the public and private sectors in relation to Canadian sovereignty and marine surveillance, environmental monitoring and change detection, and disaster management. The RCM would be government-owned and operated. On June 6, 2005, Treasury Board granted Preliminary Project Approval (PPA) for the RCM and expenditure authority for the Project Initial Planning and Identification (i.e. Phase A). During Phase A, feasibility studies were completed, user requirements were defined, and risk mitigation activities and options analysis for the bus and payload were carried out. The initial scope of work of for Phase A was completed in December 2006. Phase A was then extended to allow additional technical risk reduction activities to continue during the period prior to the Phase B contract award. This was completed in March 2008. In March 2007, Treasury Board approved a revised PPA submission to proceed to Phases B and C. Following a competitive Request for Proposal (RFP) process, PWGSC obtained authority to enter into negotiations with MDA, the prime contractor, and awarded the contract for Phase B in November 2008. The Preliminary Design (i.e. Phase B) was completed in March 2010. The contract for Phase B was subsequently amended to include the detailed design (i.e. Phase C). A second revised PPA was approved by Treasury Board in December 2010. The purpose of this revised PPA was to provide additional expenditure authority to include the procurement of long-lead items during Phase C and also to include a technology demonstration for Automatic Identification System (AIS) payloads, funded by the National Defence. The final review of the overall mission-level system detailed design, the Mission Critical Design Review (CDR), was conducted in

	November 2012. A selected set of activities, such as completing the design qualification activities and the procurement of long-lead items, pursued under Phase C were completed in November 2015. These selected activities were scheduled to be completed in March 2014 but were delayed due to technical difficulties encountered during the building of the qualification models. The delay has no impact on the project. Treasury Board granted Effective Project Approval for the RCM in December 2012, which provides expenditure and contracting authorities to complete the project and carry out the first year of RCM operations (Phases D and E1). The contract was awarded on January 9, 2013. Since contract award, planning activities were completed and major milestones achieved to initiate the implementation phase of the satellites and associated ground system. In 2013, a Deputy Ministers' Governance Committee (DMGC) was established to provide oversight, coordination and accountability on the RCM MCP. The DMGC reports to the Minister of Innovation, Science and Economic Development and provides strategic direction while making timely decisions to address issues and risks that could affect the success of the MCP. Significant progress was made in the manufacturing of the RCM satellites throughout 2015–16. Most of the satellite units have been completed for all three satellites. Assembly, integration and testing of the synthetic aperture radar (SAR) payload and AIS payload for the first two satellites have been completed. Assembly and integration of the bus for the first satellite have been completed, but challenges in completing the flight software have delayed the completion of the first bus by about six months. This will delay the start of the satellite-level assembly, integration and testing of the first satellite until fall 2016. Assembly and integration of the bus for the second satellite was started and is well underway. The detailed design phase of the RCM ground segment was completed and the building of the individual ground segment subsystems was started in the second half of 2015–16. Upgrades to the CSA headquarters at Saint-Hubert to accommodate the RCM ground segment were started and are on schedule to be completed for the end of 2016. A contract was awarded

	to SpaceX for the launch of the three RCM satellites in 2018.

Summary of Non-Recurring Expenditures ($ in millions)
(As of March 31, 2016)

	Current Estimated Total Expenditure	Actual at March 31, 2016	Future Years
RADARSAT Constellation Mission	1,089.5	618.7	470.8

Project name	James Webb Space Telescope (Webb)
Description	The James Webb Space Telescope (Webb) is a joint international mission involving National Aeronautics and Space Administration (NASA), the European Space Agency (ESA) and the CSA. The mission concept is for a large field-aperture telescope to be located 1.5 million km from Earth. Like Hubble, the Webb will be used by the astronomy community to observe targets ranging from objects within our solar system to the most remote galaxies which can be seen during their formation in the early universe. The science mission is centred on the quest to understand our origins: • Observing the very first generation of stars to illuminate the dark universe when it was less than one billion years old; • Understanding the physical processes that have controlled the evolution of galaxies over cosmic time and, in particular, identifying the processes that led to the assembly of galaxies within the first four billion years after the Big Bang; • Understanding the physical processes that control the formation and early evolution of stars in our own and other nearby galaxies; and • Studying the formation and early evolution of proto-planetary disks, and characterizing the atmospheres of isolated planetary mass objects. The Webb is scheduled for launch in 2018. Webb instruments will be designed to work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range. The Webb will have a large mirror, 6.5 metres in diameter and a sun shield that will be the size of a tennis court once deployed in outer space. Canada is providing the Fine Guidance Sensor (FGS) and the Near-Infra-Red Imager and Slitless Spectrometer (NIRISS). The FGS is integral to the attitude control system of the Webb, and consists of two fully redundant cameras that will report precise pointing information.

	Canadian expertise in this area was established previously with the successful fine error sensors for the former Far Ultraviolet Spectroscopic Explorer (FUSE) mission. Packaged with the FGS but functionally independent, the NIRISS covers the 0.7 to 5 micrometer spectral range. NIRISS provides a specialized capability for surveys of objects such as primeval galaxies, for the study of transiting planetary systems and for high-contrast imaging applications such as the detection of extra-solar planets. With COM DEV Canada as prime contractor, the James Webb Space Telescope-FGS Major Crown Project consists of the design, development, testing and integration into the spacecraft, launching and commissioning of the FGS and NIRISS. By participating in this leading-edge international space exploration mission, the CSA is actively promoting Canadian scientific expertise and innovative, advanced space technologies. The National Research Council's Herzberg Astronomy and Astrophysics (NRC Herzberg) is a key Government of Canada (GoC) partner for activities related to the development of science instruments and distribution of telescope data. In return for its overall investment in the Webb Telescope, Canada will obtain a minimum of 5% of the time on this unique space telescope. Already, the news of Canada's involvement in this international space exploration mission is inspiring youth, educators and amateur astronomers, and rallying members of Canada's world-renowned astrophysics community.
Project outcomes	This MCP contributes to Program 1.2 Space Exploration which provides valuable Canadian science, signature technologies and qualified astronauts to international space exploration endeavours. It fosters the generation of knowledge as well as technological spin-offs that contribute to a higher quality of life for Canadians. This Program appeals to the science and technology communities. It is targeted mostly towards Canadian academia and international space exploration partnerships. Canadian industry also benefits from the work generated within this Program. The contribution of the MCP to the program objectives is measured through the Performance

	Measurement Framework (PMF) (Program Alignment Architecture (PAA) results and performance indicators). Program 1.2 Space Exploration Result #1: Expansion of advanced scientific knowledge acquired through space exploration endeavours. Performance Indicator #1: Number of peer-reviewed scientific publications, reports and conference proceedings using space exploration information and produced by researchers (sciences and technologies) in Canada. Result #2: Multiple use and applications of knowledge and know-how acquired through space exploration endeavours. Performance Indicator #1: Number of terrestrial applications of knowledge and know-how acquired through space exploration endeavours. Performance Indicator #2: Number of space re-utilizations of knowledge and know-how acquired through space exploration endeavours. Sub-Program 1.2.2 Exploration Missions and Technology Result #1: Technological know-how is acquired through Space Exploration endeavors (Astronomy and Planetary). Performance Indicator #1: Proportion of the CSA missions/solutions/instruments that met their mission performance requirements at acceptance review and/or at commissioning. Result #2: Canada maintains a strategic positioning which supports its capacity to influence space exploration missions and decision-making processes in key international space exploration forums. Performance Indicator #1: Number of CSA sponsored highly qualified personnel (HQP) nominated on the International Space Exploration decision bodies.

	Result #3: CSA's participation in space exploration missions provides access to scientific data about the Solar System and the Universe. Performance Indicator #1: Number of CSA's sponsored space astronomy and planetary missions providing data to Canadian scientific community.
Industrial benefits	Most of the direct industrial benefits from the construction of the Webb-FGS and NIRISS system will accrue to Ontario.
Sponsoring department	Canadian Space Agency (CSA)
Contracting authority	Public Works and Government Services Canada (PWGSC) for the Canadian Space Agency
Participating departments	NRC Herzberg Astronomy and Astrophysics Innovation, Science and Economic Development (ISED)
Prime contractor	- COM DEV Canada, Ottawa, Ontario
Major subcontractors	- Teledyne, USA - Corning Netoptix, USA - IMP Aerospace Avionics, Canada - ABB Bomem, Canada - MDA, Canada - INO, Canada - BMV, Canada - CDA Intercorp, USA - ESTL, Europe - Bach Research Corporation, USA - Materion, USA - Camcor, Canada

Project phase	Phase D – Implementation
Major milestones	Phase A: Requirement Definition (2004) Phase B: Preliminary Design (May 2005) Phase C: Detailed Design (September 2008) Phase D: Manufacturing/Assembly, Integration/Testing, Pre-launch preparations, Launch/System Commissioning (March 2019) Phase E: Operations (part of MCP) (2024)
Progress report and explanation of variances	In March 2004, Treasury Board granted Preliminary Project Approval for Phases B, C and D. In December 2006, before the completion of Phase C, detailed design of the FGS, the CSA requested increased expenditure authority to complete the project. In February 2007, the Treasury Board granted Effective Project Approval (EPA) and the project became a Major Crown Project (MCP). In March 2007, the first Critical Design Review (CDR) for the guidance function of the FGS revealed technical issues. During the preparation of the system-level CDR, new issues became apparent. The technical issues needed to be addressed. In December 2007, Treasury Board granted a revised EPA after project costs had raised significantly due to technical issues by the end of Phase C, the detailed design phase. In 2010, NASA discovered that the infrared detectors, extremely sensitive cameras capable of “seeing” light produced by heat, were showing signs of performance degradation due to a design fault. Following investigation, NASA concluded that all detectors, including the four procured by Canada, needed to be replaced. In effect, two years after their acceptance by the project, the detectors started to show the same degradation. NASA initiated an improvement project with Teledyne Scientific & Imaging LLC to address the design issue causing the degradation. In 2011–12, work continued on hardware and software development. COMDEV Canada worked on the Proto Flight Model (PFM) which successfully completed a very stringent environmental test campaign

	during which the instrument was subjected to cryogenic temperatures over a period of 80 continuous days. Teledyne Scientific & Imaging LLC completed the detector design improvements and, pursuant to testing successfully addressed the degradation issues. NASA then initiated the procurement process for new detectors for the Webb Mission; the acquisition of the detectors for the FGS/NIRISS was under the responsibility of the CSA. The FGS Engineering Test Unit (ETU) was integrated into the NASA Goddard Space Flight Center (GSFC) test set-up and underwent system-level testing with the other science instrument engineering units. The integration test onto the Integrated Science Instrument Module (ISIM) of the Webb Telescope was successfully conducted. A technical issue surfaced with a component, the Tunable Filter Instrument (TFI), which triggered the need for a change in the design approach and led to the design and development of the Near-Infrared Imager and Slitless Spectrograph (NIRISS). This new instrument relied on existing components of the old TFI but used a different approach to cover the light spectrum required for the science mission. On July 30, 2012, the PFM FGS/NIRISS was delivered to NASA GSFC. On November 15, 2012, the PFM FGS/NIRISS was officially accepted by NASA following the successful completion of post-delivery functional tests. The FGS/NIRISS was the first instrument officially accepted by NASA as part of the James Webb Space Telescope project. As to the procurement of the four new detectors for FGS/NIRISS, the CSA and NASA agreed on cost sharing: NASA would manage the procurement with Teledyne Scientific & Imaging LLC until the detectors are completed at which point they would be procured off-the-shelf by the CSA (through PWGSC). In August 2013, NASA initiated a cryogenic test campaign with the Integrated Science Instrument Module (ISIM). The test was completed in November 2013, and the FGS/NIRISS performed as expected. The second cryogenic test campaign was conducted in 2014–15 as the integration and test activities at NASA with ISIM continued. As well, in

	2014, the FGS/NIRISS detectors were replaced after the completion of the second cryogenic test campaign. The launch date for the Webb is currently planned for October 2018. In 2007, when the project obtained Treasury Board approval for the revised EPA, the anticipated mission launch date was May 2013. Following a re-planning exercise conducted by NASA, the launch date was slipped to October 2018, extending the project life by 5.5 years. There was an associated cost increase in the mission's integration and test phase, due to NASA having originally underestimated the work needed for this phase. The scope of work remaining to be completed for this project is as follows: Although the flight instrument has now been delivered, the project is still in the implementation phase where support must be provided for the integration of the FGS/NIRISS to the spacecraft, for the launch activities and for the spacecraft commissioning activities. With all the integration and test activities at NASA having been delayed and the duration of these activities revised under the NASA re-plan, the CSA and COM DEV are required to provide direct engineering post-delivery support to NASA for FGS/NIRISS and to the Webb mission commissioning activities from 2014 up until April 2019. Official mission operations will commence after the completion of the telescope's commissioning, six months after its launch. The Webb Telescope operations center will be located in the Space Telescope Institute in Baltimore, Maryland, in the United States. Canadian scientists will be on location to directly support the operations of the FGS and NIRISS throughout the mission's operations. The operations will also be supported by engineering staff in order to be able to address technical issues if and when they occur to ensure the functionality of Canada's instruments. Ultimately this remaining scope of work and the extension of the mission schedule resulted in cost increases that could not be absorbed by the 2007 project authorities. As well, PWGSC needed contractual authorities for acquiring the new detectors under a sole-source contract with a US supplier. As a result, the CSA prepared a new submission to

	Treasury Board addressing the issues above. The submission was approved in February 2014. Treasury Board granted a revised EPA of $169.9 million (excluding taxes). In January 2016, NASA completed the third and final cryogenic test campaign of ISIM at NASA's GSFC. During this test campaign, the FGS/NIRISS performed as expected, thus successfully closing the final performance verification of Canada's contribution to the JWST. In March 2016, NASA entered the next level of spacecraft integration and testing with the joining of ISIM and the Optical Telescope Element to form the OTIS (Optical Telescope element and Integrated Science instrument module).

Summary of Non-Recurring Expenditures ($ in millions) (As of March 31, 2016)			
	Current Estimated Total Expenditure	**Actual at March 31, 2016**	**Future Years**
JWST-FGS and NIRISS	172.3	166.0	6.3

Internal Audits and Evaluations

Internal Audits Completed in 2015–16

Title of Internal Audit	Internal Audit Type	Completion Date
Audit on Governance http://asc-csa.gc.ca/eng/publications/ar-1415-0103.asp	Management and Oversight	June 2015
Audit of the Management Framework for Safety and Mission Assurance http://asc-csa.gc.ca/eng/publications/ar-1415-0102.asp	Management and Oversight	June 2015
Audit of the Management Framework of the Earth Observation Mission Program – RADARSAT Constellation Mission (RCM) http://asc-csa.gc.ca/eng/publications/ar-1415-0101.asp	Management and Oversight	September 2015
Audit of the Chief Financial Officer Attestation for Cabinet Submissions http://asc-csa.gc.ca/eng/publications/ar-1516-0101.asp	Financial Management Controls	December 2015

Evaluations in Progress or Completed in 2015–16

Title of evaluation	Status	Deputy head approval date	Link to the organization's program(s)
Evaluation of the International Market Access Program (Comprising the European Space Agency Contribution Program) of the Canadian Space Agency http://asc-csa.gc.ca/eng/publications/er-1415-0202.asp	Completed	July 2015	1.3 .Future Canadian Space Capacity
Evaluation of the Canadian Space Agency's International Space Station Assembly and Maintenance Operations Program http://asc-csa.gc.ca/eng/publications/er-1415-0201.asp	Completed	February 2016	1.2. Space Exploration
Enabling Technology Development	In progress	June 2016	1.3 .Future Canadian Space Capacity
Class Grants & Contributions	In progress	July 2016	1.1 Space Data, Information Services Several 1.2. Space Exploration 1.3 .Future Canadian Space Capacity
Earth Observation Missions, Earth Observation Data & Imagery Utilization and Ground Infrastructure	In progress	March 2017	1.1 Space Data, Information Services

Response to Parliamentary Committees and External Audits

Response to Parliamentary Committees
No response requested in 2015–16
Response to the Auditor General
No recommendations received in 2015–16
External audits conducted by the Public Service Commission of Canada or the Office of the Commissioner of Official Languages
No external audits in 2015–16

Status Report on Projects Operating With Specific Treasury Board Approval

Project Name and Project Phase	Original estimated total cost[1] (dollars)	Revised estimated total cost [2] (dollars)	Actual cost total [3] (dollars)	2015–16 Main Estimates (dollars)	2015–16 Planned Spending (dollars)	2015–16 Total authorities (dollars)	2015–16 Actual Spending (dollars)	Expected date of close–out [4]
1.1 Space Data, Information and Services								
RADARSAT-CONSTELLATION MCP EPA	600,000,000	1,089,510,532	777,160,551	195,032,608	193,467,853	193,513,216	158,478,125	2018-2019
MARITIME MONITORING AND MESSAGING MICROSATELLITE (M3MSAT) EPA	5,404,000	16,549,419	11,656,133	2,382,627	3,318,127	3,378,932	2,297,995	2016-2017
SURFACE WATER & OCEAN TOPOGRAPHY (SWOT-C)	8,496,507	8,839,507	2,421,794	2,765,480	3,451,883	3,812,317	1,272,857	2020-2021

Project Name and Project Phase	Original estimated total cost[1] (dollars)	Revised estimated total cost [2] (dollars)	Actual cost total [3] (dollars)	2015–16 Main Estimates (dollars)	2015–16 Planned Spending (dollars)	2015–16 Total authorities (dollars)	2015–16 Actual Spending (dollars)	Expected date of close–out [4]
1.2 Space Exploration								
OSIRIS-REx LASER ALTIMETER (OLA) EPA	26,696,400	36,205,564	34,131,723	2,578,728	5,387,728	6,318,456	5,323,150	2016-17
CANADIAN METROLOGY SYSTEM (CAMS) ON JAPAN's ASTRO-H SPACE OBSERVATORY SATELLITE EPA	4,767,320	5,492,691	5,492,691	109,792	377,792	406,305	331,566	2015-16
JAMES WEBB SPACE TELESCOPE MCP (JWST) EPA	67,160,000	172,268,953	166,042,302	2,462,424	3,270,424	4,252,393	3,917,073	2019-20
MOBILE SERVICING SYSTEM REPLACEMENT CAMERA (MSS RCAM)	15,465,270	18,429,835	5,680,416	5,253,792	5,253,792	5,753,859	5,574,549	2017-18
DEXTRE DEPLOYABLE VISION SYSTEM (DDVS)	23,351,302	23,351,302	1,212,542	1,730,000	1,730,000	1,225,336	1,212,542	2020-21

Project Name and Project Phase	Original estimated total cost[1] (dollars)	Revised estimated total cost [2] (dollars)	Actual cost total [3] (dollars)	2015–16 Main Estimates (dollars)	2015–16 Planned Spending (dollars)	2015–16 Total authorities (dollars)	2015–16 Actual Spending (dollars)	Expected date of close–out [4]
LIFE SCIENCE RESEARCH SYSTEM (LSRS)	15,268,161	16,657,950	137,847	272,833	272,833	137,847	137,847	2019-20
1.4 Internal Services								
DAVID FLORIDA LABORATORY INFRASTRUCTURE ACCELERATED REFIT (DFL-IAR)	12,022,802	12,022,802	2,378,115	5,042,044	4,938,640	4,949,085	2,307,398	2017-18
Total [5]	**778,631,762**	**1,399,328,555**	**1,006,314,114**	**217,630,329**	**221,469,072**	**223,747,746**	**180,853,102**	

[1] Very first Total Estimated project cost approved by Treasury Board.
[2] Most recent Total Estimated project cost approved by Treasury Board.
[3] All expenditures as of March 31st 2016
[4] Expected date (Fiscal Year) for the beginning of operations
[5] Excluding GST/QST

User Fees, Regulatory Charges and External Fees

Fee name	Fees charged for the processing of access to information requests filed under the Access to Information Act (ATIA)
Fee type	Other products and services (O)
Fee-setting authority	Access to Information Act
Year introduced	1989
Year last amended	2016
Performance standard	Response provided within 30 days following receipt of request; the response time may be extended pursuant to section 9 of the Access to Information Act. Notices of extension are to be sent within 30 days after receipt of request. The *Access to Information Act* provides fuller details.
Performance results	The CSA received 12 new requests for access to information and had four that were outstanding from the previous period. Four were reported to be processed in the following year, for a total of 12 processed requests. The response time was within time limits in 83% of the requests.
Other information	The CSA collects user fees for information requests in accordance with the Access to Information Act. The total amount of user fees collected in 2015–16 was for application fees. In accordance with TBS guidelines, no other fees were charged.

Financial Information, 2015–16 (dollars)

Forecast revenue	Actual revenue	Full cost
100	60	112,291

Financial Information, 2016–17, 2017–18 and 2018–19 (dollars)

Planning year	Forecast revenue	Estimated full cost
2016–17	60	125,000
2017–18	60	125,000
2018–19	60	125,000

Departmental Sustainable Development Strategy

Target 7.2: Green Procurement	
As of April 1, 2014, the Government of Canada (GoC) will continue to take action to embed environmental considerations into public procurement, in accordance with the federal *Policy on Green Procurement*.	
Scope and Context	
Not applicable	
Link to the Organization's Programs (Program Alignment Architecture)	
1.4 Internal Services	
Financial Performance Expectations	
Not applicable	
Performance Measurement	
Expected result	
Environmentally responsible acquisition, use and disposal of goods and services.	
Performance indicator	**Performance level achieved**
Departmental approach to further the implementation of the *Policy on Green Procurement* in place as of April 1, 2014.	Planned completion date: April 2017
Number and percentage of procurement and/or materiel management specialists who completed the Canada School of Public Service Green Procurement course (C215) or equivalent, in fiscal year 2015–16.	3 75%
Number and percentage of managers and functional heads of procurement and materiel whose performance evaluation includes support and contribution toward green procurement, in fiscal year 2015–16.	1 100%
Implementation strategy element or best practice	**Performance level achieved**
7.2.1.5. Leverage common use procurement instruments where available and feasible.	Achieved
Best Practice 7.2.3. Train acquisition cardholders on green procurement.	To be achieved April 2017
Best Practice 7.2.4. Increase awareness of the *Policy on Green Procurement* among managers.	To be achieved April 2017

Strategic Environmental Assessment
During the 2015–16 reporting cycle, the Canadian Space Agency considered the environmental effects of initiatives subject to the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*, as part of its decision-making processes. As the Canadian Space Agency did not develop any initiatives that required a strategic environmental assessment, no related public statements were produced.